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XVI.

CONTRIBUTIONS FROM THE PHYSICAL LABORATORY OF
HARVARD COLLEGE.

No. IX.—CONDENSERS AND GEISSLER'S TUBES.

BY WILLIAM P. WILSON.

IN the secondary circuit of a Ruhmkorff's coil of 6000 ohms resistance was joined a galvanometer, and successively Geissler's tubes containing CO , H , and O . The galvanometer was constructed from a Ruhmkorff's coil equal in resistance to the one used in the secondary circuit. Upon sending a spark through a Geissler's tube of CO , a deflection of 8 centimetres was given by the galvanometer.

The light was strongest in the centre of the tube; near the positive and negative poles of the platinum electrodes it was very feeble.

The color in the middle of the tube shaded into red; at the extremities it was a pale bluish-white. The light in the enlarged part of the tube, approaching the positive pole, was beautifully stratified with alternate light and dark bands. A condenser, consisting of a Leyden jar of 66.5 sq. cm. surface, was connected with the opposite poles of the coil, and a spark again passed through the Geissler's tube. The galvanometer gave the same deflection of 8 cm. as before, but the difference in light was very marked. This increase in light did not show itself in the centre of the tube, but towards the extremities; both poles, and especially the positive, becoming much more brilliant. The dark and light bands seen near the positive pole, before the introduction of the condenser, now entirely disappeared. The Geissler's tube was removed, and an equal air resistance substituted. This was done by placing near together, and in line, the broken ends of the wire. By a micrometer adjustment, these wire points could be made to recede from or approach each other, until the galvanometer gave a deflection of 8 cm. with the condenser in the circuit. Upon sending a spark through this air resistance, having previously disconnected the condenser, the deflection of the galvanometer was at once increased from 8 to 26 cm. The light did not vary as much as in the Geissler's tube,

but could easily be seen to be brighter when the condenser was in the circuit. The following is the record of observations upon three gases, and the equal air resistance, with and without a condenser: —

1. Current passing through Geissler's tube of *CO*.

With condenser, deflection = 8 cm.
 Without „ „ = 8 cm.
 With „ light increased.
 Without „ „ decreased.

2. Current passing through Geissler's tube of *H*.

With condenser, deflection = 8 cm.
 Without „ „ = 8 cm.
 With „ light increased.
 Without „ „ decreased.

3. Current passing through Geissler's tube of *O*.

With condenser, deflection = 8 cm.
 Without „ „ = 8 cm.
 With „ light increased.
 Without „ „ decreased.

4. Current passing through air resistance equal to the resistance of Geissler's tube.

With condenser, deflection = 8 cm.
 Without „ „ = 26 cm.
 With „ light increased.
 Without „ „ decreased.

Let *C*, be the condenser; *S*, the entire energy of current which would produce magnetic effect; *L*, that part of the energy expended in light; and *m*, the deflection of the galvanometer. We shall then have *in air*: —

Without *C*, $S - L = \phi(m)$
 With *C*, $S - L_1 = \phi(m_1)$
 $m = 3.25 \text{ times } m_1$
 $L < L_1$

in gas: —

Without *C*, $S - L_2 = \phi(m_2)$
 With *C*, $S - L_3 = \phi(m_3)$
 $m_2 = m_3$
 $L_2 < L_3$.

In other terms, having an air resistance equal to that of the Geissler's tube, the introduction of a condenser *increased* the *light*, and *decreased* the *deflection* of the galvanometer. Or replacing the air resistance with

the Geissler's tube, the introduction of a condenser gave a marked *increase* in the *light*, much more so than in air, but no *decrease* in the *deflection* of the galvanometer.

An attempt was made by Vierodt's method to measure the increase and decrease of light consequent upon the introduction and withdrawal of the condenser ; but it was found that the intensity was not sufficient to obtain any accurate results.

It will thus be seen that the effect on the galvanometer was the same when any one of the gases was used ; and also that, when the Geissler's tubes were in the circuit, the condenser might be introduced or withdrawn with no visible result in the deflection of the galvanometer.

With an air resistance the spark was a small one with two bright points and a dark centre. This spark gave a larger deflection of the galvanometer, but very little light. When the condenser was introduced into the circuit, the character of the spark was changed at once to a larger one of even intensity. The light was greatly increased, and the deflection of the galvanometer correspondingly decreased. But with the Geissler's tubes in the circuit, the only difference which could be observed between the sparks when the condenser was introduced or withdrawn was in light. The galvanometer continued to give the same deflection in both cases.

A Geissler tube, therefore, affords a test for the presence and action of a condenser in the secondary circuit of an induction coil when a galvanometer fails to do so.